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# Student Characteristics Associated With Positive Attitudes Toward Interprofessional Education

Risa Liang Wong  
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Student Characteristics Associated With Positive Attitudes Toward  
Interprofessional Education

A Thesis Submitted to the  
Yale University School of Medicine  
in Partial Fulfillment of the Requirements for the  
Degree of Doctor of Medicine

by

Risa Liang Wong

2015

## STUDENT CHARACTERISTICS ASSOCIATED WITH POSITIVE ATTITUDES TOWARD INTERPROFESSIONAL EDUCATION.

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**ABSTRACT:** Attitudes of health professional students may determine the effectiveness of interprofessional education (IPE). We sought to identify student characteristics associated with more positive attitudes toward IPE by surveying a cohort of medical (M), nursing (N), and physician associate (PA) students first and third year using the Readiness for Interprofessional Learning Scale (RIPLS) and Interdisciplinary Education Perception Scale (IEPS). We collected demographic and experiential information and performed one-way ANOVA, independent and paired t-tests, and multiple linear regression. 110 of 213 students (52%) completed the RIPLS and 106 (50%) completed the IEPS at both time points. Nursing students consistently had the highest RIPLS scores (third-year scores 75.1 M, 83.9 N, 77.7 PA,  $p < 0.001$ ), and medical students the lowest IEPS scores (third-year scores 56.5 M, 61.6 N, 62.0 PA,  $p < 0.001$ ). Women had higher RIPLS scores than men both years (third-year scores 80.6 vs. 76.9,  $p = 0.03$ ), and higher IEPS scores in the third year (60.4 vs. 57.8,  $p = 0.02$ ). Students who participated in interprofessional extracurriculars had higher RIPLS scores in third year than those who did not (80.4 vs. 76.0,  $p = 0.03$ ). Only first-year score and professional program predicted third-year RIPLS or IEPS score ( $p \leq 0.001$  both models). In conclusion, positive attitudes toward IPE are associated with professional program, gender, and participation in interprofessional extracurricular activities.

ACKNOWLEDGEMENTS: This research was funded in part by the Office of Student Research at the Yale School of Medicine. The author would also like to thank Sangchoon Jeon for advising on statistical analysis and Matthew Balanda and Anthony G. Luczak for assistance with literature review.

## TABLE OF CONTENTS

INTRODUCTION .....	1
STATEMENT OF PURPOSE .....	7
METHODS .....	8
RESULTS .....	12
DISCUSSION .....	27
REFERENCES .....	40
APPENDICES .....	45

## INTRODUCTION

With the increasing complexity and fragmentation of health systems throughout the world, the importance of interprofessional health care teams who can work collaboratively to optimize use of their individual skills, share case management, and provide better health services to their respective communities is becoming more apparent (1). In the U.S., the earliest use of "modern" interprofessional health care teams can be traced back to 1948 and the Montefiore Hospital in New York City, when an administrator named Dr. Martin Cherkasky developed a home care hospital outreach program using teams of physicians, nurses, and social workers (2). Several years later, faculty at the University of Washington's Child Health Center attempted to create a broad interprofessional approach to family health care by utilizing both faculty and students from medicine, nursing, psychiatry, social work, nutrition, psychology, dentistry, dental hygiene, and medical technology (3). This effort was notable not only because of the novel interprofessional interaction between faculty, but also because of the shared education between trainees; this may have represented one of the earliest examples of interprofessional education for health professional students (4).

Interprofessional education (IPE) can be defined as occurring "when students from two or more professions learn about, from, and with each other to enable effective collaboration and improve health outcomes" (1). Although in the past the term "interdisciplinary education" has been used interchangeably with IPE, IPE has become the preferred term due to its accuracy; there may be multiple disciplines within professions (e.g. a cardiologist and endocrinologist are both physicians), but the word "interprofessional" denotes that two or more entirely separate professions are involved

(5). Why is IPE a desirable concept in health care? The rationale was well summarized by Roy J. Romanow, Chair of the Royal Commission on the Future of Health Care in Canada, in his report entitled "Building on Values: The Future of Health Care in Canada": "If health care providers are expected to work together and share expertise in a team environment, it makes sense that their education and training should prepare them for this type of working arrangement" (6). Health professionals who do not receive preparation for interprofessional teamwork through training or education are likely not as well equipped for working in health care teams in real-world practice environments (1).

Traditionally, health professional students from different schools have minimal contact with each other and few collaborative experiences during their education. A change began in the 1960s, when health professional students and student health organizations became increasingly dissatisfied with traditional medical and nursing education. They clamored for interprofessional summer projects in primary care, and the Student American Medical Association (later known as the American Medical Student Association, or AMSA) began to sponsor these opportunities (4,7). Concurrently, the Kaiser Permanente organization was becoming the first large-scale, successful example of managed care, challenging traditional health care delivery models (8). There was also a proliferation of health occupations and professions during this time, reflecting increasing specialization and subspecialization in health care (4). The rising sentiment that health care teams were the way of the future culminated in 1972, when the Institute of Medicine held a conference entitled "Educating for the Health Team" and issued a widely cited report which stated "The reason for a team is to do the job you cannot do with a single person. The need for the team approach [in health care] was seen arising

from... the great increase of scientific knowledge and technology during the past 25 years and the heightened public expectations of the past 10 years" (9). The report strongly supported the concept of IPE for health professionals, stating "At the administrative level... academic health centers must recognize an obligation to engage in interdisciplinary education and patient care, and regional consortia of health professional schools not otherwise associated with academic health centers should be formed to foster educational teamwork".

The 1970s also saw financial support from the federal government for IPE. In the early 1970s, there was a brief-lived Health Professions Special Project Grants Program which awarded support for educational initiatives promoting interprofessional training and team approaches. In 1974, Dr. David Kindig, who had previously helped establish the Institute for Health Team Development with funding from the Robert Wood Johnson Foundation, became Deputy Director of the Bureau of Health Manpower and created an Office of Interdisciplinary Programs (4,10). With the establishment of this office, funding under the name of Health Manpower Education Initiative Awards began to support interprofessional team training in primary care. From 1974 to 1978, awards were given to AMSA, the universities of Hawaii, Nevada, Michigan State, North Carolina, Washington, and Utah, and the University of California at San Francisco. The funded initiatives at these institutions varied greatly. Some of the programs were integrated portions of the regular curriculum, while others were extracurricular; most of them were elective rather than required experiences; some were delivered during the academic year while others during summer or vacation; and finally, some programs provided team training before clinical experience, while others provided such training in conjunction with clinical



experience (4). These schools convened in 1976 to report on their early experiences, with workshop proceedings published in 1978 under the title "Interdisciplinary Health Team Training" (11). However, most of the federal support for these programs ceased by 1980, and with it much of the forward momentum for IPE. Without external funding, the majority of programs quickly faded away (4).

More recently, there is renewed interest in improving the quality of IPE for U.S. health professionals, spurred on by another landmark report by the Institute of Medicine in 2003 entitled "Health Professions Education: A Bridge to Quality" (12). This report cites the ability to work in interdisciplinary teams as one of five core competencies that students and working professionals should cultivate, and states that promoting interdisciplinary or interprofessional collaboration is central to improving the quality and safety of patient care. Several years later, in 2010, the World Health Organization (WHO) Study Group on Interprofessional Education and Collaborative Practice published extensive recommendations entitled "Framework for Action on Interprofessional Education and Collaborative Practice", stating that the WHO recognizes "interprofessional collaboration in education and practice as an innovative strategy that will play an important role in mitigating the global health workforce crisis...

Interprofessional education is a necessary step in preparing a 'collaborative practice-ready health workforce that is better prepared to respond to local health needs" (1). Research has also begun to show that interprofessional team interventions are among the most effective in effecting desirable clinical outcomes such as reduced hemoglobin A1c, low-density lipoprotein levels, and blood pressure, strengthening the argument for IPE as a practice that will eventually lead to improved quality of care (13,14).

Accordingly, new accreditation standards from the Liaison Committee on Medical Education now require for the first time that medical schools prepare students for interprofessional teamwork (15). Similar accreditation standards exist for U.S. physician associate (PA) programs (16), and although not an accreditation requirement, IPE is recommended content for U.S. nursing programs (17). Despite these new program requirements and recommendations, many U.S. health professional schools have yet to incorporate robust IPE into training, and professional training silos are still the norm. Many of the barriers to implementing IPE have likely remained the same over time, including traditional cultures and attitudes in the health professions – for example, within medicine, traditional notions of hierarchy still abound which place nurses and PAs in a subordinate position to physicians as presumably less skilled and less knowledgeable health care workers, causing both physicians and physicians-in-training to be less likely to see a need for true interprofessional collaboration and education (18,19). Other barriers to implementing effective IPE include administrative challenges, packed curricula, and lack of substantial or sustained funding for IPE initiatives (20).

In comparison to the U.S., recent momentum for IPE appears to be slightly stronger in the U.K., where numerous groups have published data in the past decade on IPE interventions at a single institution (21-23). Though some of the interventions described in these studies have been successful, it is not clear that implementation of these initiatives in the U.S., or even other sites in the U.K., would result in the same findings or even be feasible due to significant geographic differences and variability between institutions, professional programs, and students. For IPE to be effectively incorporated across the board, it is clear that a better understanding is needed of common

elements of successful IPE, as well as the relationship between student characteristics and IPE outcomes (24). Only then will individual institutions be able to design IPE experiences tailored to their students and unique characteristics.

Within student characteristics that may affect IPE outcomes, differing attitudes and readiness towards IPE and its tenets of collaborative learning and practice are thought to be an important factor, as this would affect both the degree of engagement in and the educational yield of IPE activities (25,26). Accordingly, numerous instruments have been developed to assess attitudes, readiness, and interactional factors needed for IPE among health professionals. In practice, these instruments are used both to assess the baseline attitudes of health professionals and health professional students and to measure change in attitudes after IPE interventions. Unfortunately, most published tools lack sufficient information about their psychometric properties and have only been used once or twice in the literature. The two most commonly used and psychometrically validated instruments are the Readiness for Interprofessional Learning Scale (RIPLS) and Interdisciplinary Education Perception Scale (IEPS) (26-28). Both consist of a series of statements with agreement indicated on a Likert scale. Previous studies using the RIPLS and IEPS vary in their institution-specific results, but have generally found that attitudes toward IPE tend to stay the same or become more negative over time, and that students who enter training with negative attitudes toward IPE may gain the least from IPE initiatives; these IPE experiences may even reinforce such negative attitudes (29). Some studies have found an improvement in RIPLS or IEPS scores after specific IPE interventions (30,31).

At Yale, the RIPLS and the IEPS were administered to first-year medical, nursing, and PA students in 2011 (32). The intent was to assess baseline attitudes of Yale health professional students in preparation for a pilot interprofessional clinical skills course, and to help fill a knowledge gap about the association between U.S. student characteristics and attitudes toward IPE. Though the interprofessional clinical skills course was canceled before implementation due to larger curricular changes, the authors realized from the preliminary data that there were both striking baseline differences between student groups as well as naturally occurring interprofessional experiences that students might have engaged in since matriculation into their programs. In order to elucidate the persistence of these student differences and the effects of various types of interprofessional experiences, the authors readministered the RIPLS and IEPS to the same cohort of students two years later. Thus, the current study presents longitudinal data on a cohort of Yale health professional students and their attitudes toward IPE.

#### STATEMENT OF PURPOSE

The purpose of this study is to identify characteristics of Yale health professional students, both demographic and experiential, associated with positive attitudes toward IPE. We hypothesized that demographic differences would persist over time and that certain interprofessional experiences during training, such as volunteering at the student-run HAVEN Free Clinic, would result in more positive attitudes toward IPE compared to baseline.

## METHODS

The RIPLS and the IEPS were used to assess attitudes toward IPE (27,28). The RIPLS was first developed in the U.K. by Parsell & Bligh in 1999 using a cohort of 120 second-year undergraduate students in medicine, nursing, occupational therapy, physical therapy, orthoptics, therapy and diagnostic radiography, and dentistry. It consisted of 19 items and 3 subscales with an initial internal consistency value of  $\alpha = 0.90$  (27). In 2005, another group in the U.K., McFadyen, Webster, Strachan, Figgins, Brown, & McKechnie, administered the RIPLS to a cohort of 308 first-year undergraduate students in nursing, occupational therapy, physical therapy, podiatry, prosthetics and orthotics, radiography, dietetics, and social work (33). They resurveyed the same cohort a year later, and performing content analysis as well as confirmatory factor analysis within structural equation modeling (SEM), came up with 4 subscales. Looking at key goodness-of-fit indicators in SEM, this 4-subscale model appeared to be superior to the original 3-subscale version. In their analysis, McFadyen et al. reverse coded RIPLS items #10-12 due to the negative wording of these statements, and in a subsequent study (34), they also found that reverse-coding items #17-19 improved their internal consistency value from  $\alpha = 0.81$  to  $\alpha = 0.88$ . The final RIPLS items, subscales, and scoring used by McFadyen et al. was adopted by our study and can be found in Appendix A.

The IEPS was first developed in the U.S. by Luecht et al. in 1990 using a cohort of 143 undergraduate health professional students, master's students, administrators, and clinicians in the fields of occupational therapy, medical records, speech pathology and audiology, and therapeutic recreation. The original instrument consisted of 18 items and 4 subscales with an internal consistency value of  $\alpha = 0.87$  (28). McFadyen et al. again used

their same cohort of 308 undergraduate health professional students and the same methodology they used to revise the RIPLS to develop an alternative subscale model for the IEPS, resulting in a 12-item instrument with 3 subscales (35). Again, this version of the IEPS was adopted by our study, and is detailed in Appendix B.

From December 2011 to January 2012, all first-year medical, nursing, and PA students at our institution were asked by Talwalkar et al. to complete an online survey using a unique, anonymous identifier code (32). To help boost participation, in-class reminders were given by faculty in the three programs. The survey included the RIPLS, IEPS, and demographic questions on age, sex, professional program, previous degrees, and previous health care experience. From September to November 2013, student author RW administered a follow-up survey to the same cohort of students, who were now in the third year of their programs. The follow-up survey was built and administered by RW through the online platform Qualtrics, and included a request for the same anonymous identifier code, the RIPLS and IEPS items, and questions on experiences during training such as participation in interprofessional extracurricular activities (HAVEN Free Clinic, Columbus House, Downtown Evening Soup Kitchen, Healthy Neighbors, Neighborhood Health Project, Reproductive Health Education and Advocacy, Healthcare Collective, Healthcare Improvement Interest Group/Institute for Healthcare Improvement Open Chapter, or the Latino Medical Student Association/Student National Medical Association Community Health Fair), interprofessional courses (Global Health or Tropical Medicine), and relationships with students in other health professional programs (related to classroom, clinical, laboratory and research, housing, extracurricular, social and romantic, or other activities). Students were assured that participation in the follow-

up survey was voluntary, confidential, and would not affect course evaluations in any way. To improve response rates, RW personally delivered reminders about the survey to student subjects by visiting each third-year medical clerkship during a didactic period, the PA students on a "call-back" didactic day, and the nursing students during one of their required courses. RW also coordinated with faculty and administrators in the three health professional programs to encourage students to participate in the survey. Email reminders were sent on a weekly basis to subjects who had not yet participated in the follow-up survey through Qualtrics, which has the capability to track survey participation while retaining subject anonymity.

This study was granted exemption from review by the institutional review board at Yale University, and the research protocol was separately approved by the committee charged with reviewing research using medical students as subjects at the Yale School of Medicine.

### *Statistical Analyses*

All statistical analyses were performed by RW. Students' surveys were matched by their identifier code, and students who did not complete both surveys with the same identifier code were excluded from analysis. Of note, because of the relatively high response rate to the follow-up survey, it was deduced that many students had responded to both surveys but failed to provide the same identifier code for each. Age was dichotomized into less than versus greater or equal to 24 years of age at program entry, as students in the former category likely entered their programs straight from college. Previous degrees were categorized as "science, only" versus "at least one non-science

degree". Because nearly all students reported some amount of previous health care experience prior to enrolling in training programs at Yale, previous health care experience was categorized as less than versus greater or equal to 1 full-time year or its equivalent, 2000 hours. Respondents who reported participating in student organizations with participants from multiple health professional programs were categorized as having participated in interprofessional extracurricular activities. One extracurricular activity, volunteering at the student-run free clinic known as HAVEN Free Clinic, was analyzed separately as it had the most participants and deliberately promotes interprofessional teamwork. The HAVEN Free Clinic's educational mission is "To educate Yale health professional students about primary care and the value of working in health care teams; to allow students to gain experience in community health; and to expose students to the challenges of managing patient care with limited resources" (36). Of note, medical, nursing, and PA students have flexible roles in this clinic and can equally serve in almost any position. Respondents who reported participating in courses enrolling students from multiple programs were categorized as having participated in interprofessional courses, and students who reported meaningful relationships with students in other programs outside of classroom, clinical, laboratory, or extracurricular activities were categorized as having interprofessional relationships outside of school.

In analyzing RIPLS and IEPS responses, the previously validated subscales described by McFadyen et al. (22) were used, dividing the RIPLS into four subscales entitled "Teamwork & Collaboration", "Negative Professional Identity", "Positive Professional Identity", and "Roles & Responsibility" (Appendix A) and the IEPS into



three subscales entitled "Competence & Autonomy", "Perceived Need for Cooperation", and "Perception of Actual Cooperation" (Appendix B).

One-way analysis of variance (ANOVA) and independent t-tests were used for comparisons between groups, and paired t-tests for comparisons between time points. Levene's test was used to determine whether equal variances could be assumed for comparisons. Where a significant difference was found among medical, nursing, and PA students, Duncan's test was used for pair-wise comparisons. For multivariable analysis, each subscale was analyzed using multiple linear regression with simultaneous variable entry and unstandardized coefficients (B) were reported to reflect unit change in scores due to each variable. All statistical analyses were conducted with SPSS 22 (SPSS Inc., Chicago, IL).

## RESULTS

### *RIPLS – Overall Trends*

110 out of 213 students (52%) completed the RIPLS both years, including 45 out of 101 (45%) medical students (M), 48 out of 81 (59%) nursing students (N), and 17 out of 31 (55%) PA students. Overall, total RIPLS scores and Teamwork & Collaboration, Negative Professional Identity, and Positive Professional Identity subscale scores did not change from first year to third year. Scores decreased in the subscale Roles & Responsibilities (11.8 to 11.0,  $p < 0.001$ ) (Table 1).

**Table 1.** RIPLS - Average Scores by Demographic Variables

		Teamwork & Collaboration			Negative Professional Identity			Positive Professional Identity			Roles & Responsibilities		
Variable		Y1	Y3	<i>p</i>	Y1	Y3	<i>p</i>	Y1	Y3	<i>p</i>	Y1	Y3	<i>p</i>
All Students		39.2±0.4	39.2±0.5	0.85	12.8±0.2	12.7±0.2	0.84	16.2±0.2	16.4±0.2	0.41	11.8±0.2	11.0±0.2	<0.001
Program													
Medical	(N=45)	38.2±0.7 <sup>A</sup>	37.8±0.8 <sup>A</sup>	0.62	12.8±0.3	12.0±0.3 <sup>A</sup>	0.047	15.8±0.4 <sup>A,B</sup>	15.9±0.4 <sup>A,B</sup>	0.76	10.2±0.3 <sup>A</sup>	9.4±0.2 <sup>A</sup>	0.02
Nursing	(N=48)	40.6±0.5 <sup>B</sup>	41.1±0.5 <sup>B</sup>	0.22	12.9±0.2	13.5±0.2 <sup>B</sup>	0.10	17.0±0.3 <sup>B</sup>	17.1±0.3 <sup>B</sup>	0.49	13.0±0.2 <sup>B</sup>	12.2±0.2 <sup>B</sup>	0.03
PA	(N=17)	37.6±1.0 <sup>A</sup>	37.8±1.0 <sup>A</sup>	0.86	12.4±0.5	12.5±0.4 <sup>A</sup>	0.93	15.2±0.5 <sup>A</sup>	15.5±0.6 <sup>A</sup>	0.66	12.7±0.4 <sup>B</sup>	11.9±0.3 <sup>B</sup>	0.08
	<i>p</i>	0.005	0.001		0.68	0.001		0.02	0.02		<0.001	<0.001	
Sex													
Male	(N=35)	37.7±0.9	37.9±1.0	0.91	12.4±0.3	12.5±0.4	0.84	15.8±0.5	16.3±0.4	0.26	10.6±0.4	10.0±0.3	0.14
Female	(N=75)	39.8±0.4	39.9±0.5	0.88	12.9±0.2	12.8±0.2	0.71	16.4±0.3	16.4±0.3	0.86	12.3±0.2	11.5±0.2	0.001
	<i>p</i>	0.03	0.04		0.16	0.40		0.28	0.77		<0.001	<0.001	
Age at Entry													
<24	(N=43)	38.6±0.7	38.7±0.6	0.81	12.9±0.3	12.1±0.3	0.03	16.0±0.4	16.0±0.4	1.00	10.8±0.4	10.1±0.3	0.05
≥24	(N=67)	39.5±0.5	39.6±0.6	0.94	12.7±0.2	13.1±0.2	0.18	16.4±0.3	16.6±0.3	0.29	12.4±0.2	11.6±0.2	0.002
	<i>p</i>	0.24	0.36		0.57	0.004		0.48	0.20		<0.001	<0.001	
Previous Degrees													
Science only	(N=79)	39.2±0.5	38.9±0.6	0.61	12.7±0.2	12.6±0.2	0.78	16.3±0.3	16.3±0.3	0.92	11.6±0.3	10.9±0.2	0.008
Non-Science	(N=31)	39.1±0.7	40.2±0.7	0.13	12.9±0.4	12.9±0.3	0.95	16.1±0.5	16.6±0.4	0.15	12.4±0.4	11.3±0.3	0.009
	<i>p</i>	0.90	0.20		0.69	0.51		0.74	0.51		0.08	0.32	
Previous Health Care Experience													
<2000 hrs/	(N=66)	39.1±0.5	39.0±0.6	0.90	12.9±0.2	12.6±0.2	0.41	16.1±0.3	16.4±0.3	0.36	11.2±0.3	10.6±0.3	0.07
1 yr													
≥2000 hrs /	(N=44)	39.2±0.7	39.6±0.6	0.56	12.6±0.3	12.9±0.3	0.49	16.3±0.4	16.4±0.4	0.88	12.7±0.3	11.6±0.2	<0.001
1 yr													
	<i>p</i>	0.88	0.55		0.43	0.49		0.70	0.99		0.001	0.009	

<sup>A,B</sup>Within one subscale and time point, indicates program scores significantly different by Duncan's test for pairwise comparisons.

### *RIPLS – Program Factors*

In both first and third year, nursing students had the highest total RIPLS scores (first year 83.3 N, 77.1 M, 77.9 PA,  $p < 0.001$ ; third year 83.9 N, 75.1 M, 77.7 PA,  $p < 0.001$ ) (Fig. 1).

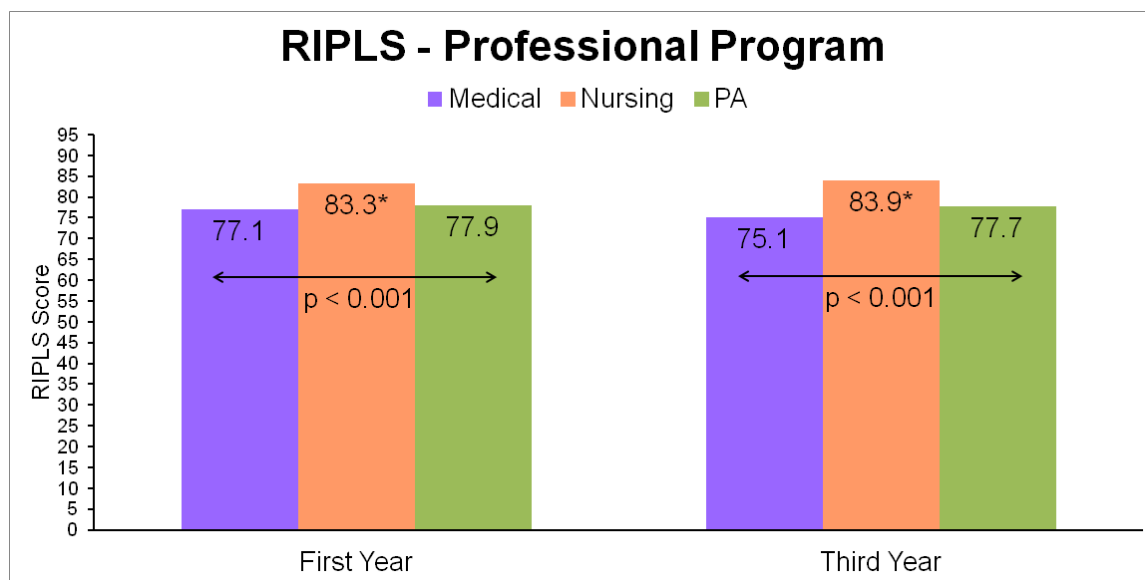


Fig. 1: RIPLS – Professional Program.

Symbols \* and † indicate programs significantly different from the others by Duncan's test for pairwise comparisons. At both time points, nursing students had the highest RIPLS scores.

In fact, as the results in Table 1 show, nursing students tended to have higher scores than medical or PA students in all of the subscales at both time points. PA students had the lowest scores in Positive Professional Identity (first year 17.0 N, 15.8 M, 15.2 PA,  $p = 0.02$ ; third year 17.1 N, 15.9 M, 15.5 PA,  $p = 0.02$ ), whereas medical students had the lowest Roles & Responsibility scores at both time points (first year 10.2 M, 13.0 N, 12.7

PA,  $p < 0.001$ ; third year 9.4 M, 12.2 N, 11.9 PA,  $p < 0.001$ ) and decreased their Negative Professional Identity scores from first to third year (12.8 to 12.0,  $p = 0.047$ ).

### *RIPLS – Demographic Factors*

Women had higher total RIPLS scores than men in both first and third year (first year 81.5 vs. 76.6,  $p = 0.001$ ; third year 80.6 vs. 76.7,  $p = 0.03$ ) (Fig. 2).

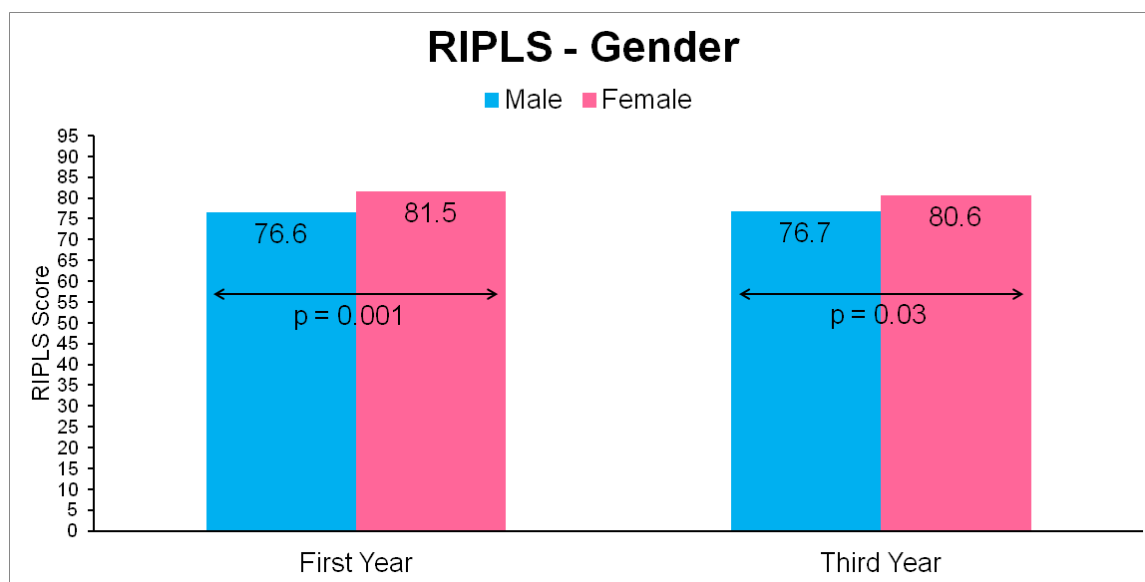


Fig. 2: RIPLS – Gender.

Women had higher RIPLS scores than men at both time points.

By subscale, at both time points, women had higher scores than men in Teamwork & Collaboration (first year 39.8 vs. 37.7,  $p = 0.03$ ; third year 39.9 vs. 37.9,  $p = 0.04$ ) and Roles & Responsibilities (first year 12.3 vs. 10.6,  $p < 0.001$ ; third year 11.5 vs. 10.0,  $p < 0.001$ ). Older students aged  $\geq 24$  years old at program entry had higher total RIPLS scores by third year than younger students (80.9 vs. 76.9,  $p = 0.02$ ) (Fig. 3).

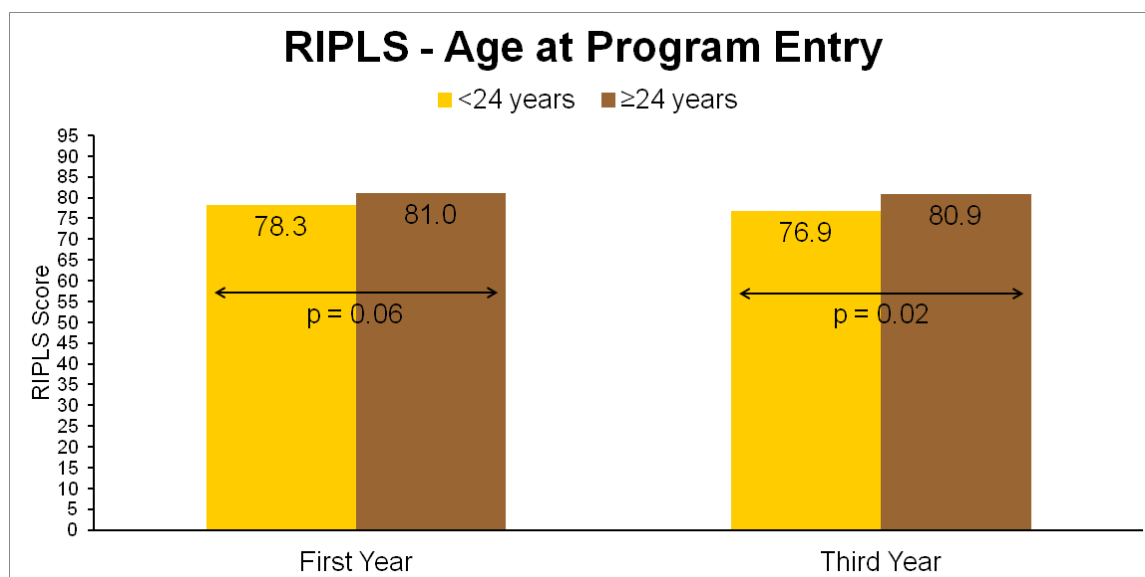


Fig. 3: RIPLS – Age at Program Entry.

Older students had higher RIPLS scores than younger students by third year.

By subscale, older students had higher Roles & Responsibilities scores than younger students at both time points (first year 12.4 vs. 10.8,  $p < 0.001$ ; third year 11.6 vs. 10.1,  $p < 0.001$ ). Students < 24 years old at program entry decreased their Negative Professional Identity scores from first to third year (12.9 to 12.1,  $p = 0.03$ ), leading to lower third year scores than older students (12.1 vs. 13.1,  $p = 0.004$ ). Students with > 2000 hours or > 1 full-time year of previous health care experience had higher Roles & Responsibilities scores than students with less experience at both time points (first year 12.7 vs. 11.2,  $p = 0.001$ ; third year 11.6 vs. 10.6,  $p = 0.009$ ). There was no difference between students with or without a non-science degree in either total RIPLS score or any of the subscales (Table 1).

#### *RIPLS – Experiential Factors*

Regarding experiences students had during training, students who participated in interprofessional extracurriculars had higher total RIPLS scores in third year than those who did not (80.4 vs. 76.0,  $p = 0.03$ ) (Fig. 4).

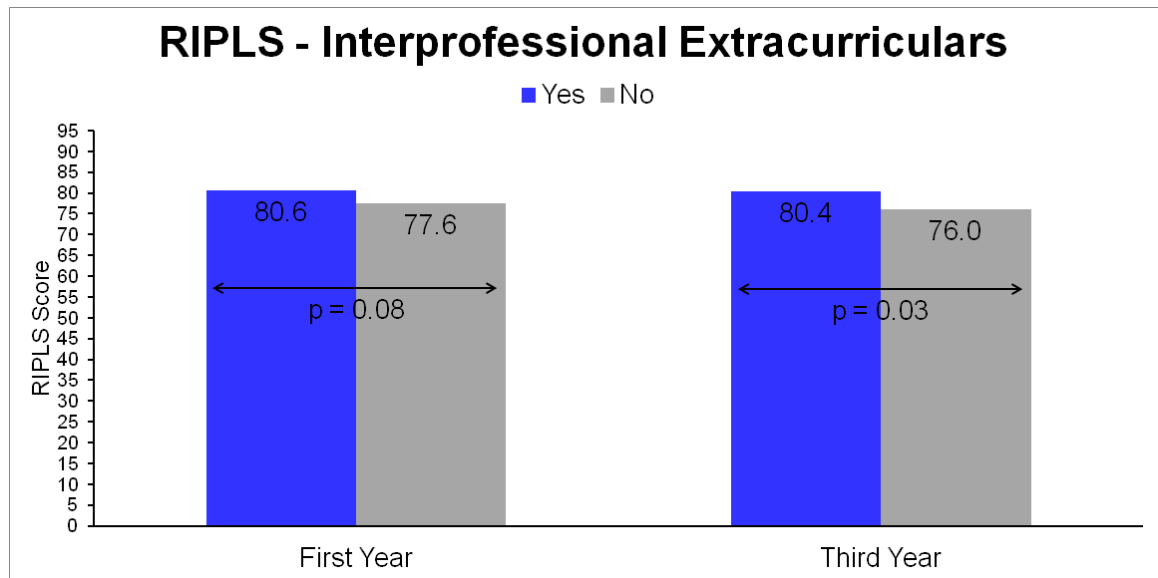


Fig. 4: RIPLS – Interprofessional Extracurriculars.

Students who participated in interprofessional extracurriculars had higher RIPLS scores than those who did not by third year.

By subscale, those who participated in interprofessional extracurriculars had higher Teamwork & Collaboration scores than those who did not in third year (39.7 vs. 37.5,  $p = 0.04$ ) and higher Positive Professional Identity scores at both time points (first year 16.5 vs. 15.2,  $p = 0.02$ ; third year 16.7 vs. 15.4,  $p = 0.03$ ) (Table 2). In third year, students who participated in the HAVEN Free Clinic had higher scores than those who did not in Negative Professional Identity (13.3 vs. 12.3,  $p = 0.006$ ) and Positive Professional Identity (17.0 vs. 16.0,  $p = 0.04$ ). There was no difference between students who did or

**Table 2.** RIPLS - Average Scores by Experiential Variables

		Teamwork & Collaboration			Negative Professional Identity			Positive Professional Identity			Roles & Responsibilities		
Variable		Y1	Y3	<i>p</i>	Y1	Y3	<i>p</i>	Y1	Y3	<i>p</i>	Y1	Y3	<i>p</i>
Interprofessional Extracurriculars													
No	(N=25)	37.8±0.8	37.5±1.0	0.76	12.5±0.3	12.1±0.4	0.39	15.2±0.5	15.4±0.5	0.55	12.2±0.4	11.0±0.3	0.009
Yes	(N=85)	39.5±0.4	39.7±0.5	0.73	12.8±0.2	12.9±0.2	0.82	16.5±0.3	16.7±0.3	0.54	11.7±0.3	11.0±0.2	0.006
	<i>p</i>	0.06	0.04		0.46	0.06		0.02	0.03		0.37	0.87	
Student-Run Free Clinic													
No	(N=62)	38.7±0.5	38.8±0.5	0.93	12.8±0.2	12.3±0.2	0.07	15.9±0.3	16.0±0.3	0.83	11.7±0.3	11.0±0.2	0.01
Yes	(N=48)	39.7±0.6	39.8±0.8	0.87	12.7±0.3	13.3±0.3	0.12	16.6±0.4	17.0±0.3	0.31	11.9±0.3	11.1±0.3	0.005
	<i>p</i>	0.24	0.27		0.61	0.006		0.13	0.04		0.60	0.69	
Interprofessional Courses													
No	(N=72)	39.3±0.5	39.0±0.6	0.66	12.7±0.2	12.5±0.2	0.49	16.2±0.3	16.4±0.3	0.49	11.6±0.3	10.8±0.2	0.002
Yes	(N=38)	38.9±0.7	39.7±0.6	0.21	12.8±0.3	13.1±0.3	0.60	16.3±0.4	16.4±0.4	0.67	12.2±0.4	11.5±0.3	0.06
	<i>p</i>	0.67	0.45		0.73	0.14		0.85	0.93		0.19	0.06	
Outside Relationships <sup>A</sup>													
No	(N=79)	39.2±0.5	39.4±0.6	0.78	12.7±0.2	12.5±0.2	0.59	16.2±0.3	16.5±0.3	0.30	11.9±0.3	11.0±0.2	0.001
Yes	(N=31)	38.9±0.7	38.8±0.7	0.84	12.9±0.3	13.1±0.3	0.64	16.3±0.4	16.2±0.4	0.76	11.6±0.5	11.0±0.4	0.09
	<i>p</i>	0.74	0.55		0.61	0.15		0.85	0.61		0.54	0.87	

<sup>A</sup>Relationships formed outside of classroom, clinical, laboratory, or extracurricular activities

did not participate in interprofessional courses or relationships in either total RIPLS score or any of the subscales.

### *RIPLS – Multivariate Analyses*

In multiple linear regression analyses, only first year score and professional program predicted third year RIPLS score ( $p < 0.001$ ). By subscale (Table 3), both first year Teamwork & Collaboration score ( $B = 0.3$ ,  $p = 0.004$ ) and professional program ( $B = 3.0$ ,  $p = 0.02$  for N vs. M) predicted third year Teamwork & Collaboration score. Similarly, both first year Roles & Responsibilities score ( $B = 0.2$ ,  $p = 0.03$ ) and professional program ( $B = 2.4$ ,  $p < 0.001$  for N vs. M;  $B = 1.8$ ,  $p = 0.001$  for PA vs. M) predicted third year Roles & Responsibilities score. Only professional program predicted third year Negative Professional Identity score ( $B = 1.8$ ,  $p = 0.001$  for N vs. M) and only first year Positive Professional Identity score predicted third year Positive Professional Identity Score ( $B = 0.6$ ,  $p < 0.001$ ).

### *IEPS – Overall Trends*

106 out of 213 students (50%) completed the IEPS both years, including 43 out of 101 (43%) medical students, 48 out of 81 (59%) nursing students, and 15 out of 31 (48%) PA students. Overall, total IEPS scores and Perceived Need for Cooperation and Perception of Actual Cooperation subscale scores did not change from first to third year. Competence & Autonomy subscale scores showed a near-significant decrease (25.4 to 24.9,  $p = 0.052$ ) (Table 4).



**Table 3.** RIPLS – Multiple Linear Regression for Predictors of Third-Year Scores

	Teamwork & Collaboration		Negative Professional Identity		Positive Professional Identity		Roles & Responsibilities	
Variable	$R^2=0.23$ B(SE) <i>p</i>		$R^2=0.25$ B(SE) <i>p</i>		$R^2=0.43$ B(SE) <i>p</i>		$R^2=0.50$ B(SE) <i>p</i>	
Y1 Score	0.3(0.1)	0.004	0.04(0.1)	0.68	0.6(0.1)	<0.001	0.2(0.1)	0.03
Program								
Medical <sup>A</sup>								
Nursing	3.0(1.3)	0.02	1.8(0.5)	0.001	0.7(0.6)	0.22	2.4(0.4)	<0.001
PA	0.5(1.4)	0.71	0.6(0.6)	0.34	0.3(0.7)	0.63	1.8(0.5)	0.001
Sex								
Male	0.2(1.1)	0.86	0.6(0.4)	0.19	0.8(0.5)	0.11	-0.2(0.4)	0.56
Female <sup>A</sup>								
Age at Entry								
<24 <sup>A</sup>								
≥24	-0.9(1.0)	0.40	0.5(0.4)	0.19	0.3(0.5)	0.56	0.2(0.3)	0.59
Previous Degrees								
Science only <sup>A</sup>								
Non-Science	0.2(1.0)	0.84	-0.4(0.4)	0.37	0.3(0.5)	0.58	-0.5(0.3)	0.13
Previous Health Care Experience								
<2000 hrs/1 yr <sup>A</sup>								
≥2000 hrs/1 yr	-0.1(1.0)	0.92	-0.5(0.4)	0.18	-0.3(0.4)	0.45	-0.2(0.3)	0.52
Interprofessional Extracurriculars								
No <sup>A</sup>								
Yes	1.5(1.2)	0.21	0.5(0.5)	0.32	0.3(0.5)	0.57	0.2(0.4)	0.59
Student-Run Free Clinic								
No <sup>A</sup>								
Yes	-0.4(1.0)	0.68	0.5(0.4)	0.24	0.6(0.5)	0.25	-0.4(0.3)	0.29
Interprofessional Courses								
No <sup>A</sup>								
Yes	0.9(1.0)	0.35	0.1(0.4)	0.71	-0.2(0.5)	0.63	0.4(0.3)	0.25
Outside Relationships <sup>B</sup>								
No <sup>A</sup>								
Yes	-0.1(1.0)	0.92	0.7(0.4)	0.08	-0.3(0.5)	0.49	0.3(0.3)	0.39

<sup>A</sup>Reference groups within categorical variables<sup>B</sup>Relationships formed outside of classroom, clinical, laboratory, or extracurricular activities

**Table 4.** IEPS - Average Scores by Demographic Variables

		Competence & Autonomy			Perceived Need for Cooperation			Perception of Actual Cooperation		
Variable		Y1	Y3	<i>p</i>	Y1	Y3	<i>p</i>	Y1	Y3	<i>p</i>
All Students		25.4±0.2	24.9±0.3	0.052	10.7±0.1	10.8±0.1	0.75	23.7±0.3	23.9±0.3	0.46
Program										
Medical	(N=43)	24.9±0.3 <sup>A</sup>	24.3±0.4	0.07	10.9±0.2	11.0±0.2	0.47	21.5±0.4 <sup>A</sup>	21.2±0.4 <sup>A</sup>	0.48
Nursing	(N=48)	25.4±0.4 <sup>A</sup>	25.6±0.4	0.65	10.5±0.2	10.4±0.2	0.46	24.7±0.4 <sup>B</sup>	25.6±0.3 <sup>B</sup>	0.04
PA	(N=15)	27.0±0.5 <sup>B</sup>	24.5±0.6	0.003	10.8±0.3	11.1±0.2	0.39	26.9±0.6 <sup>C</sup>	26.4±0.7 <sup>B</sup>	0.60
	<i>p</i>	0.02	0.07		0.33	0.03		<0.001	<0.001	
Sex										
Male	(N=32)	25.8±0.4	24.5±0.5	0.002	10.6±0.2	10.8±0.3	0.56	22.6±0.6	22.5±0.7	0.81
Female	(N=74)	25.3±0.3	25.1±0.3	0.55	10.8±0.1	10.8±0.1	0.91	24.2±0.4	24.5±0.3	0.30
	<i>p</i>	0.31	0.38		0.50	0.98		0.02	0.004	
Age at Entry										
<24	(N=42)	25.8±0.3	25.1±0.4	0.07	10.8±0.2	11.0±0.2	0.34	22.7±0.5	22.8±0.5	0.73
≥24	(N=64)	25.2±0.4	24.8±0.4	0.25	10.7±0.1	10.6±0.2	0.67	24.4±0.4	24.6±0.4	0.51
	<i>p</i>	0.25	0.59		0.61	0.10		0.009	0.007	
Previous Degrees										
Science only	(N=75)	25.7±0.3	25.1±0.3	0.06	10.7±0.1	10.9±0.1	0.23	23.8±0.4	23.8±0.4	0.91
Non-Science	(N=31)	24.8±0.4	24.4±0.5	0.47	10.8±0.2	10.5±0.2	0.14	23.4±0.5	24.3±0.5	0.09
	<i>p</i>	0.11	0.27		0.74	0.13		0.59	0.50	
Previous Health Care Experience										
<2000 hrs/1 yr	(N=63)	25.3±0.3	24.9±0.4	0.26	10.8±0.1	10.9±0.1	0.45	23.2±0.4	23.3±0.4	0.84
≥2000 hrs/1 yr	(N=43)	25.7±0.4	24.9±0.5	0.12	10.6±0.2	10.5±0.2	0.72	24.4±0.5	24.8±0.5	0.36
	<i>p</i>	0.44	0.89		0.23	0.07		0.06	0.02	

<sup>A,B,C</sup> Within one subscale and time point, indicates program scores significantly different by Duncan's test for pairwise comparisons.

### IEPS – Program Factors

In both first and third year, medical students had the lowest total IEPS scores, while PA students had the highest total IEPS scores in first year only (first year 57.3 M, 60.6 N, 64.7 PA,  $p < 0.001$ ; third year 56.5 M, 61.6 N, 62.0 PA,  $p < 0.001$ ) (Fig. 5).

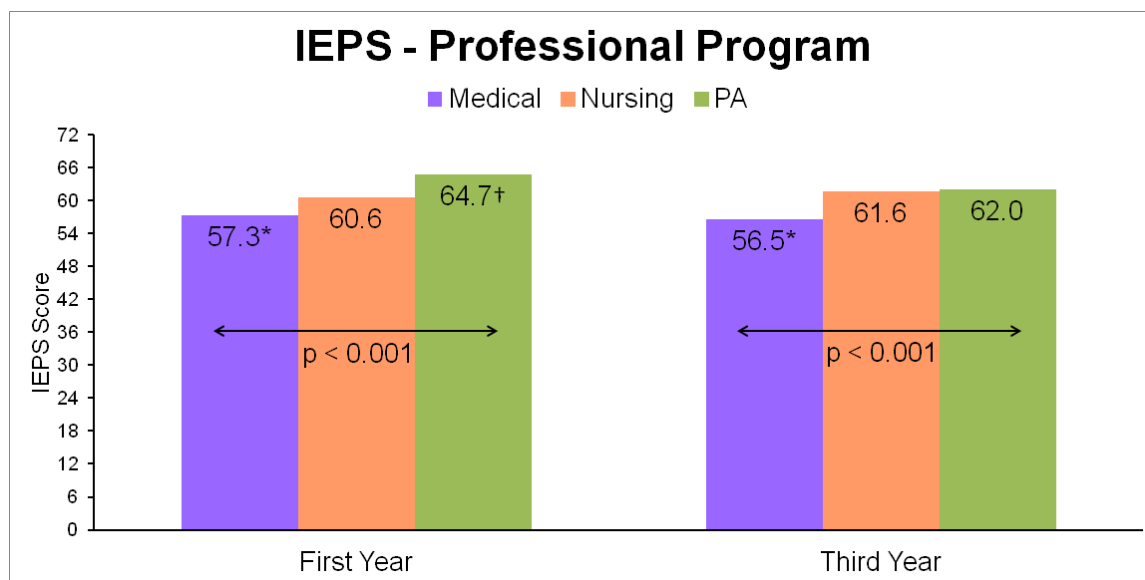


Fig. 5: IEPS – Professional Program.

Symbols \* and † indicate programs significantly different from the others by Duncan's test for pairwise comparisons. At both time points, medical students the lowest IEPS scores. In first year, PA students had the highest IEPS scores, but this difference went away by third year.

By subscale, as the results in Table 4 show, medical students had lower Perception of Actual Cooperation scores than nursing or PA students at both time points (first year 21.5 M, 24.7 N, 26.9 PA,  $p < 0.001$ ; third year 21.2 M, 25.6 N, 26.4 PA,  $p < 0.001$ ). PA students had higher Perception of Actual Cooperation scores than medical or nursing students in first year, but not in third year. Similarly, PA students had the highest

Competence & Autonomy scores in first year (27.0 PA, 24.9 M, 25.4 N,  $p = 0.02$ ), but not in third year due to a decrease in their scores (27.0 to 24.5,  $p = 0.003$ ). Nursing students had the lowest Perceived Need for Cooperation scores in third year (10.4 N, 11.0 M, 11.1 PA,  $p = 0.03$ ) but increased their Perception of Actual Cooperation scores from first to third year (24.7 to 25.6,  $p = 0.04$ )

### *IEPS – Demographic Factors*

Women had higher total IEPS scores than men in third year (60.4 vs. 57.8,  $p = 0.02$ ) (Fig. 6).

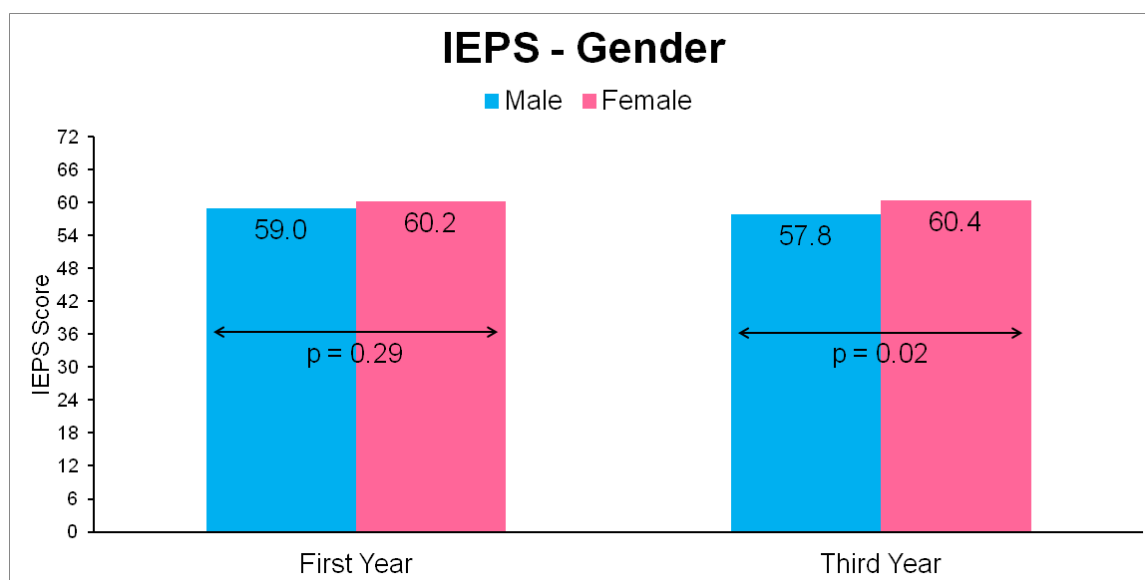


Fig. 6: IEPS – Gender.

Women had higher RIPLS scores than men at both time points and higher IEPS scores by third year.

By subscale, women had higher Perception of Actual Cooperation scores than men in both first and third year (first year 24.2 vs. 22.6,  $p = 0.02$ ; third year 24.5 vs. 22.5,  $p =$

0.004). Men's Competence & Autonomy scores decreased from first to third year (25.8 to 24.5,  $p = 0.002$ ). Students  $\geq 24$  years old at program entry had higher Perception of Actual Cooperation scores than younger students at both time points (first year 24.4 vs. 22.7,  $p = 0.009$ ; third year 24.6 vs. 22.8,  $p = 0.007$ ). Students with  $> 2000$  hours or  $> 1$  full-time year of previous health care experience had higher Perception of Actual Cooperation scores than students with less experience in third year (24.8 vs. 23.3,  $p = 0.02$ ). There was no difference between students with or without a non-science degree in either total IEPS scores or any of the subscales (Table 4).

#### *IEPS – Experiential Factors*

Regarding experiences students had since entering training (Table 5), there was no difference between students who did or did not participate in interprofessional extracurriculars, courses, or relationships. However, students who did not participate in the HAVEN Free Clinic decreased their Competence & Autonomy scores from first to third year (25.6 to 24.8,  $p = 0.01$ ). Students who participated in interprofessional courses decreased their Competence & Autonomy scores from first to third year (25.9 to 24.8,  $p = 0.02$ ).

#### *IEPS – Multivariate Analyses*

In multiple linear regression analyses, only first-year score and professional program predicted third-year IEPS score ( $p = 0.001$ ). By subscale (Table 6), both first year Competency & Autonomy score ( $B = 0.5$ ,  $p < 0.001$ ) and professional program ( $B = 1.6$ ,  $p = 0.03$  for N vs. M) predicted third year Competence & Autonomy score.

**Table 5.** IEPS - Average Scores by Experiential Variables

		Competence & Autonomy			Perceived Need for Cooperation			Perception of Actual Cooperation		
Variable		Y1	Y3	<i>p</i>	Y1	Y3	<i>p</i>	Y1	Y3	<i>p</i>
Interprofessional Extracurriculars										
No	(N=22)	26.0±0.6	25.5±0.6	0.27	10.5±0.3	10.6±0.3	0.68	24.3±0.6	24.8±0.5	0.22
Yes	(N=84)	25.3±0.3	24.8±0.3	0.10	10.8±0.1	10.8±0.1	0.86	23.5±0.4	23.7±0.4	0.69
	<i>p</i>	0.20	0.28		0.42	0.60		0.32	0.16	
Student-Run Free Clinic										
No	(N=59)	25.6±0.3	24.8±0.4	0.01	10.7±0.1	10.8±0.2	0.50	23.7±0.4	23.7±0.5	0.97
Yes	(N=47)	25.3±0.4	25.1±0.4	0.68	10.8±0.2	10.7±0.2	0.82	23.7±0.5	24.1±0.5	0.31
	<i>p</i>	0.52	0.62		0.56	0.94		0.94	0.55	
Interprofessional Courses										
No	(N=70)	25.2±0.3	25.0±0.3	0.49	10.7±0.1	10.8±0.1	0.51	23.4±0.4	23.6±0.4	0.56
Yes	(N=36)	25.9±0.5	24.8±0.5	0.02	10.8±0.2	10.7±0.2	0.65	24.3±0.6	24.5±0.5	0.63
	<i>p</i>	0.21	0.69		0.69	0.71		0.17	0.20	
Outside Relationships <sup>A</sup>										
No	(N=76)	25.3±0.3	24.9±0.3	0.23	10.7±0.1	10.7±0.1	0.86	23.6±0.4	24.0±0.4	0.30
Yes	(N=30)	25.9±0.5	25.0±0.5	0.10	10.8±0.2	10.9±0.2	0.73	23.9±0.6	23.7±0.7	0.81
	<i>p</i>	0.30	0.89		0.63	0.54		0.73	0.75	

<sup>A</sup>Relationships formed outside of classroom, clinical, laboratory, or extracurricular activities

**Table 6.** IEPS – Multiple Linear Regression for Predictors of Third-Year Scores

	Competence & Autonomy		Perceived Need for Cooperation		Perception of Actual Cooperation	
Variable	$R^2=0.33$		$R^2=0.27$		$R^2=0.54$	
	B(SE)	<i>p</i>	B(SE)	<i>p</i>	B(SE)	<i>p</i>
Y1 Score	0.5(0.1)	<0.001	0.4(0.1)	<0.001	0.3(0.1)	<0.001
Program						
Medical <sup>A</sup>						
Nursing	1.6(0.7)	0.03	-0.3(0.3)	0.27	3.4(0.8)	<0.001
PA	-0.6(0.9)	0.49	0.2(0.4)	0.58	3.5(1.0)	<0.001
Sex						
Male	-0.4(0.6)	0.57	-0.2(0.3)	0.43	-0.1(0.6)	0.81
Female <sup>A</sup>						
Age at Entry						
<24 <sup>A</sup>						
≥24	-0.4(0.6)	0.51	-0.1(0.3)	0.83	-0.4(0.6)	0.48
Previous Degrees						
Science only <sup>A</sup>						
Non-Science	-0.8(0.6)	0.16	-0.2(0.3)	0.35	-0.2(0.6)	0.75
Previous Health Care Experience						
<2000 hrs/1 yr <sup>A</sup>						
≥2000 hrs/1 yr	-0.4(0.6)	0.45	-0.2(0.2)	0.32	0.04(0.5)	0.95
Interprofessional Extracurriculars						
No <sup>A</sup>						
Yes	-0.8(0.7)	0.24	0.1(0.3)	0.67	-1.3(0.7)	0.06
Student-Run Free Clinic						
No <sup>A</sup>						
Yes	0.5(0.6)	0.41	-0.03(0.3)	0.89	0.7(0.6)	0.25
Interprofessional Courses						
No <sup>A</sup>						
Yes	-0.3(0.6)	0.60	-0.1(0.2)	0.59	0.0(0.6)	1.00
Outside Relationships <sup>B</sup>						
No <sup>A</sup>						
Yes	0.2(0.6)	0.70	0.1(0.2)	0.67	-0.2(0.6)	0.79

<sup>A</sup>Reference groups within categorical variables<sup>B</sup>Relationships formed outside of classroom, clinical, laboratory, or extracurricular activities

Similarly, both first year Perception of Actual Cooperation score ( $B = 0.3$ ,  $p < 0.001$ ) and professional program ( $B = 3.4$ ,  $p < 0.001$  for N vs. M;  $B = 3.5$ ,  $p < 0.001$  for PA vs. M) predicted third year Perception of Actual Cooperation score. Only first year Perceived Need for Cooperation score predicted third year Perceived Need for Cooperation score ( $B = 0.4$ ,  $p < 0.001$ ).

## DISCUSSION

Consistent with previous studies (22,29,37), RIPLS and IEPS scores were high across programs and subscales; this indicates the encouraging result that students from all programs report positive attitudes and readiness for interprofessional learning. Also consistent with previous findings, RIPLS and IEPS scores displayed no change over time in total score or in most subscales, indicating that attitudes are largely static over time despite a variety of interprofessional experiences that students may participate in over the course of training. This suggests that designing effective IPE that results in improving students' attitudes towards interprofessional collaboration and practice may be quite a challenging task; even in the few studies in the literature where improvement in RIPLS and IEPS scores was seen after a targeted IPE intervention, it is not known whether those improved attitudes toward IPE persisted over time (30,31). Health professional schools may then need to incorporate assessment of applicants' attitudes toward IPE into admissions processes if their goal is to create a future health workforce ready for interprofessional collaboration. However, some scholars have suggested that even taking this approach may not be effective if health professional students otherwise disposed to think positively of interprofessional collaboration lack role models in clinical practice who are carrying out such collaboration effectively (18).



While most RIPLS and IEPS subscales showed no change over time, there were a couple of exceptions. For example, the near-significant decrease in the IEPS Competence & Autonomy subscale, which includes items "Individuals in my profession are very positive about their contributions and accomplishments" and "Individuals in my profession are extremely competent", may reflect a loss of idealism pertaining to respondents' professions (29,38). As exposure to currently practicing health professionals increases greatly throughout training, especially as compared to before matriculation into a health professions school, it is inevitable that students may encounter some examples of their future profession that they regard as negative. This may temper their initial high levels of agreement with these and similar items. For example, in a thematic analysis of 272 stories of events written by 135 third-year medical students at the Indiana University School of Medicine which "taught them something about professionalism and professional values", one medical student wrote, "I've been surprised by some of the poor technique of my private doctors and also some of their medical decisions.... A new patient had come in for a physical exam and also for a referral to see an orthopedic surgeon because she had a history of hip fracture/repair. She was ready to have children and wanted to get checked out. This private doctor did not agree with the patient's getting a referral because he didn't find it very important at the moment. He told her to get pregnant, then he would send her to orthopedics. I could tell that this patient was very concerned about her hip and really wanted a referral. He still denied her request. He felt like this patient was difficult and decided that he did not want to be her doctor. He asked her to find a new doctor and left. I felt very bad for this patient. She had tears in her eyes. I apologized and she left." Another student wrote, "Throughout this month, I had the

opportunity to work under two different physicians. The first had a great attitude at all times... Unfortunately, the second physician was quite different. Her business-like and cold attitude made the rest of my service much less enjoyable—and the rest of my team, previously with constant smiles, now looked irritated at being at the hospital. In addition, when pimped, we were made to feel inferior if we did not know the correct answers. I'm glad that we had the prior staff, because I believe that if I had had the latter physician during the whole service, I would not be considering medicine as a career choice" (39).

On a similar note, the significant decrease in the RIPLS Roles & Responsibilities subscale may result from increased exposure to the complexities and changing landscape of the health care system. This subscale includes items "I'm not sure of what my professional role will be" and "The function of nurses and therapists is mainly to provide support for doctors". The subscale was reverse-coded, meaning that decreased scores in this subscale over time indicate higher levels of agreement with these statements. While greater experience with the complexities of our health care system may counter-intuitively make health professional students less sure of what their own professional role will be than when they entered training, exposure to traditional medical hierarchy may influence health professional students, particularly those training to become physicians themselves, to believe increasingly that non-physician health professionals exist mainly to fulfill a supportive role. This idea is supported by much of the literature on the hidden and informal curricula for health professional students, which many medical educators have recognized are the most powerful determinants of future health professionals' perceptions of acceptable behaviors and values, more so than didactic experiences in the classroom (40-42). In the same study of medical student stories of events surrounding

professionalism, communicating and working in teams was a latent or subdominant theme in almost 10% of anecdotes. One medical student wrote, "The attending, residents, and interns on my service ignored the pharmacy student on rotation with our team. I don't know if it was arrogance, pride, vanity, or a combination of them, but they never praised the student for anything he suggested that was correct nor did they ever take the time to teach or learn from the student. I was embarrassed for myself and everyone involved" (39). While this student was able to reflect on the experience and decide not to follow the example of his or her professional role models, other medical students confronted with the same informal curriculum may simply internalize such behavior and values. On the other side, health professional students such as the pharmacy student in the anecdote may internalize behavior directed towards themselves in a way that affects their sense of professional role and identity.

With regard to professional programs, differences persisted and, in some cases, became greater over time. Nursing students maintained the highest total RIPLS scores of any program while medical students continued to have the lowest total IEPS scores from first to third year. In the RIPLS Negative Professional Identity subscale, where higher scores indicate higher levels of disagreement with statements that learning with other health care students is unnecessary or unproductive, nursing students developed the highest scores of any program by third year while medical students decreased their scores in third year compared to first year. These differences between medical and nursing students are supported by most previous studies (29,43,44), but not all (37,45); the variation may be due to differences between programs and students from diverse institutions and geographies, as study institutions were located in the U.K., Norway,

Sweden, Canada, Singapore, and beyond. Our study results would indicate that Yale nursing students are especially collaborative in spirit compared to other Yale health professional students, consistent with the tradition in the U.S. and most other countries of nursing being a caring, collaborative profession which values team-based approaches (43,46). This program effect may be more pronounced in our study as Yale's School of Nursing is one of the top nursing schools in the U.S. and is exclusively an advanced degree program, offering master's degree and doctorate programs of study. While traditionally medicine has been considered a more competitive field than nursing, Yale nursing students are quite accomplished and are more likely to have chosen nursing over medicine for reasons of personal preference rather than ability. One reason for making such a choice may be differences in professional philosophy between nursing and medicine (32).

Conversely, it has been hypothesized in previous studies that medical students display the least positive attitudes towards IPE and interprofessional collaboration because medical training has historically idealized the notion of the independent, self-sufficient physician and remains enamored of traditional professional silos (18). Again, these notions are reinforced and perpetuated with the hidden and informal curricula that medical students experience (39-41). A provocative but legitimate notion is that physicians will continue to resist IPE and interprofessional collaboration in order to maintain and protect their relatively dominant status, unless issues of medical hierarchy are thoughtfully and adequately addressed. To quote an article speculating on what it will take to get physicians to truly participate in interprofessionalism, "The literature suggests that IPE aims to 'change the culture' of health professional interaction to 'a system of

cooperating independent equals who contribute to a common vision of health'. This is sometimes referred to as 'flattening hierarchies.' Left unsaid is that this will presumably flatten the privileged position of doctors. If IPE programmes aim to reduce doctors' traditional status, power and decision-making responsibility, it is critical to contemplate how doctors will be encouraged to engage in this process... In his theory of status relations, Milner demonstrates that the limited availability of status makes it a particularly valuable resource. Status is a relative ranking, diminishing as it is shared, unlike wealth which can increase generally. Grade inflation, for example, leads to the reduced status of A's as a symbol of academic excellence. Status can be redistributed, but the total amount available remains fixed; for a group with lower status to move up, a higher status group must necessarily lose status. It is, therefore, not possible for doctors to maintain their present high status in the health care system and at the same time have the status of other health care professionals increase. Any redistribution inevitably reduces the status of doctors" (42). The article concludes that IPE initiatives need to consider the effect of power differentials on collaborative potential, and that focusing on skills that have been shown to improve patient outcomes may be a good way to engage physicians or physicians-in-training. The article also warns that divergence between formal IPE curricula and hidden or informal curricula in actual clinical settings will most likely lead to cynicism, and suggests that existing high-functioning health care teams should be examined to better understand how they manage hierarchy and authority.

Sex differences consistent with previous studies (23,29,45) persisted over time, with women scoring higher on RIPLS and IEPS subscales and men decreasing their IEPS Competence & Autonomy scores from first to third year. Similar to nursing having a

reputation as a more caring and collaborative profession as compared to other health professions, women traditionally value collaboration, teamwork, and interpersonal skills more than men (47); this appears to manifest in their reported attitudes toward IPE. As 94% of nursing students in our study were women compared to 44% of medical students and 59% of PA students, the question arises whether gender was the true factor in programmatic differences. However, in multivariate analysis, program turned out to be a significant factor in predicting third year RIPLS and IEPS scores while gender was not significant, indicating that the influence of program was stronger than that of gender.

Differences by age and prior health care experience consistent with previous studies (23,29) also persisted. Older and more experienced students maintained higher scores in the RIPLS Roles & Responsibilities subscale, disagreeing more with the statements, "The function of nurses and therapists is mainly to provide support for doctors", "I'm not sure of what my professional role will be", and "I have to acquire much more knowledge and skills than other health care students". As other studies have noted, it would make sense that older students and those with more health care experience prior to entering their training program would have a stronger sense of their own professional role as well as a recognition and respect for the roles of other health professionals (23,29). Older students and those with more health care experience also maintained higher scores in the IEPS Perception of Actual Cooperation subscale, indicating more agreement with statements that individuals in their chosen profession do work well with each other and those in other health professions. It is possible that this represents a type of self-selection bias, where older and more experienced students who have already witnessed strong positive examples within their chosen health profession or who have

firm positive beliefs about their chosen health profession are more likely to apply and matriculate into training programs. In contrast, younger students decreased their RIPLS Negative Professional Identity subscale scores in third year compared to first year, indicating higher levels of agreement with statements such as "I don't want to waste my time learning with other health care students" and "Clinical problem-solving skills can only be learned with students from my own department". Rather than becoming more open to IPE, younger students seem to become more focused on their own professional silos as training continues. Again, this may in part represent a self-selection bias as younger students who enter health professions training straight from college may tend to be more single-minded in their focus and less patient with IPE which can be difficult, take time, and may not immediately yield tangible dividends (4,24).

Of the three types of experiences during training we examined, only participation in interprofessional extracurriculars seemed to make a difference in attitudes towards IPE. It was associated with higher RIPLS Teamwork & Collaboration subscale scores in third year, indicating higher levels of agreement with items such as "Learning with the other students will help me become a more effective member of a health care team" and "Team-working skills are essential for all health care students to learn". In particular, participation in the student-run HAVEN Free Clinic seemed to be beneficial, being associated with higher RIPLS Negative Professional Identity and Positive Professional Identity subscale scores in third year. This indicated higher levels of agreement with statements such as "Shared learning with other health care students will help me to communicate better with patients and other professionals" and lower levels of agreement with statements such as "It is not necessary for graduate health care students to learn

together". Being involved in the HAVEN Free Clinic may also have had a protective effect on IEPS Competence & Autonomy subscale scores, maintaining high levels of agreement with statements such as "Individuals in my profession are very positive about their contributions and accomplishments", as students who did not participate in the HAVEN Free Clinic decreased their scores in that subscale from first to third year. This latter result is interesting, and perhaps results from exposure to passionate volunteer faculty staffing the clinic as well as positive interactions with other student volunteers within the same professional program. Overall, these differences in RIPLS and IEPS scores between participants in interprofessional extracurriculars and non-participants may be due in part to natural differences between the two groups, as participants had higher RIPLS Positive Professional Identity subscale scores at baseline prior to engaging in interprofessional extracurricular activities. However, all other baseline scores among participants and non-participants were similar, suggesting that the actual experience of participation itself had a significant affect on student attitudes.

In agreement with Glen & Reeves (48), and in contrast to what some other groups have hypothesized (20,29,49), because participation in interprofessional courses and personal relationships outside of school had no effect on RIPLS or IEPS scores, our findings suggest that simply enrolling students from different health professions in the same classes or facilitating natural contact outside the classroom does not have a positive effect on attitudes toward IPE. Instead, our results surrounding interprofessional extracurriculars suggest that it may be most effective for students to work together in a context that models interprofessional care to reach shared goals. It has been suggested before that practice-based learning is likely more effective than classroom IPE



(48,50,51); indeed, some groups have found classroom IPE to have little impact or even negative impact on student attitudes, despite the use of small-group problem-solving or otherwise interactive material (29,50,52,53). Our data expand on the concept of practice-based learning by suggesting that meaningful community service, not just traditional health care settings where students work in prescribed practice roles, may serve as effective IPE. This is suggested because of the wide range of interprofessional extracurricular activities that were analyzed in our study, the majority of which do not place health professional students in traditional practice roles but rather feature students working collaboratively in flexible roles to service the community in some way. If a shared goal of service is a crucial component to effective IPE, then it makes sense that the less directed nature of sitting side by side in a classroom with students from other health professions or simply socializing with them outside of school does not result in more positive attitudes toward interprofessionalism. In addition to being more effective, a service-learning model of IPE where students are given real problems to solve requiring dependence on their teammates may also have practical benefits over other models in not requiring as generous a staff-to-student ratio or as skilled an IPE facilitator, both cited as potential barriers to IPE (48,54).

Finally, consistent with previous studies (23), the results of our multivariable analyses suggest that baseline attitudes toward IPE and professional program have the strongest effect on attitudes toward IPE later in training. This suggests two potential recommendations for health professional programs serious about improving the future of interprofessional teamwork and collaboration. One, as baseline attitudes have such a strong effect on future attitudes toward IPE and as RIPLS and IEPS scores stayed

relatively constant over time in our study, institutions may want to assess current admissions policies and whether they place value on abilities and attitudes important for successful IPE to begin with (20,37). The results of our study in concert with other published studies on IPE imply that starting with a group of students who value collaboration and are receptive to IPE at baseline may have a larger effect on interprofessional outcomes than the most well-planned IPE initiative (22,29,30). Two, institutions may want to identify positive examples of interprofessionalism, such as the School of Nursing at Yale University, and learn best practices from them.

### *Limitations*

Limitations of our study include a small sample size at a single institution; significant variation may exist between institutions due to geographic and other differences, though our results are consistent with most other studies. A second limitation is possible selection bias, as the survey was voluntary with response rates of about 50%; students who took the time to fill out the survey may have been more interested in notions of interprofessionalism than those who did not, and thus were biased to report more positive attitudes toward IPE than non-respondents. However, selection bias is an issue for all survey research, and our response rates were comparable to other studies of health professional students in the literature. Third, although the results of our study show overall positive attitudes and readiness for interprofessional learning among students, it is possible that social desirability bias may have shaded some students' answers; despite this potential bias, we were still able to see negative trends in attitudes. Fourth, the initial survey was administered between December 2011 and January 2012, yet the first year

health professional students began training in September 2011; it is possible that some of the students in the cohort may have already briefly engaged in interprofessional courses, personal relationships, or extracurricular activities that affected their responses to the baseline survey. Fifth, medical, nursing, and PA curricula vary with respect to length of training and how quickly students rotate on the wards; it is possible that stage in training or amount of clinical exposure could have affected responses, but this was not taken into account in the timing of the follow-up survey or in analysis of responses. By the time the second survey was administered, all health professional students had engaged in a minimum of three months of clinical rotations. Sixth, we did not take into account the quality or nature of previous health care experience or degree of involvement in interprofessional extracurricular activities, though we did take into account quantity of previous health care experience. Finally, our study did not include health professional students from the Yale School of Public Health. The initial survey was administered to assess baseline attitudes toward IPE prior to the launch of an interprofessional clinical skills course enrolling medical, nursing, and PA students; thus baseline data was not collected for public health students.

### *Conclusion*

In conclusion, health professional students differ in their attitudes toward IPE. In our study, being a nursing student, female student, older student, and having more previous health care experience were associated with having more positive attitudes toward IPE, and these findings persisted over time. Compared with having classes or personal relationships with students from other programs, only participating in

interprofessional extracurricular activities was associated with developing more positive attitudes toward IPE. Thus, institutions seeking to implement effective IPE may want to consider service-learning models where students work together to accomplish shared goals. Finally, baseline attitudes toward IPE and professional program had the strongest predictive effect on attitudes toward IPE in third year, suggesting that institutions consider both their admissions policies and best interprofessional practices within programs successful at promoting IPE.

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## APPENDICES

**Appendix A. RIPLS – Subscales and Scoring**

Subscale	Item No.	Item	Scoring
Teamwork & Collaboration	1	Learning with the other students will help me become a more effective member of a health care team	Min. Score = 9, Max. Score = 45 1 = Strongly Disagree 2 = Disagree 3 = Neutral 4 = Agree 5 = Strongly Agree
	2	Patients would ultimately benefit if health care students worked together to solve patient problems	
	3	Shared learning with other health care students will increase my ability to understand clinical problems	
	4	Learning with health care students before qualifications would improve relationships after qualification	
	5	Communication skills should be learned with other health care students	
	6	Shared learning will help me to think positively about other professionals	
	7	For small group learning to work, students need to trust and respect each other	
	8	Team-working skills are essential for all health care students to learn	
	9	Shared learning will help me to understand my own limitations	
Negative Professional Identity	10	I don't want to waste my time learning with other health care students	Min. Score = 3, Max. Score = 15 1 = Strongly Agree 2 = Agree 3 = Neutral 4 = Disagree 5 = Strongly Disagree
	11	It is not necessary for graduate health care students to learn together	
	12	Clinical problem-solving skills can only be learned with students from my own department	
Positive Professional Identity	13	Shared learning with other health care students will help me to communicate better with patients and other professionals	Min. Score = 4, Max. Score = 20 1 = Strongly Disagree 2 = Disagree 3 = Neutral 4 = Agree 5 = Strongly Agree
	14	I would welcome the opportunity to work on small-group projects with other health care students	
	15	Shared learning will help to clarify the nature of patient problems	
	16	Shared learning before qualification will help me become a better team worker	
Roles & Responsibility	17	The function of nurses and therapists is mainly to provide support for doctors	Min. Score = 3, Max. Score = 15 1 = Strongly Agree 2 = Agree 3 = Neutral 4 = Disagree 5 = Strongly Disagree
	18	I'm not sure of what my professional role will be	
	19	I have to acquire much more knowledge and skills than other health care students	

### Appendix B. IEPS – Subscales and Scoring

Subscale	Item No.	Item	Scoring
Competence & Autonomy	1	Individuals in my profession are well-trained	Min. Score = 5, Max. Score = 30 1 = Strongly Disagree 2 = Disagree 3 = Somewhat Disagree 4 = Somewhat Agree 5 = Agree 6 = Strongly Agree
	5	Individuals in my profession are very positive about their goals & objectives	
	7	Individuals in my profession are very positive about their contributions and accomplishments	
	10	Individuals in my profession trust each other's professional judgment	
	13	Individuals in my profession are extremely competent	
Perceived Need for Cooperation	6	Individuals in my profession need to cooperate with other professions	Min. Score = 2, Max. Score = 12 1 = Strongly Disagree 2 = Disagree 3 = Somewhat Disagree 4 = Somewhat Agree 5 = Agree 6 = Strongly Agree
	8	Individuals in my profession must depend upon the work of people in other professions	
Perception of Actual Cooperation	2	Individuals in my profession are able to work closely with individuals in other professions	Min. Score = 5, Max. Score = 30 1 = Strongly Disagree 2 = Disagree 3 = Somewhat Disagree 4 = Somewhat Agree 5 = Agree 6 = Strongly Agree
	14	Individuals in my profession are willing to share information and resources with other professionals	
	15	Individuals in my profession have good relations with people in other professions	
	16	Individuals in my profession think highly of other related professions	
	17	Individuals in my profession work well with each other	